

CHAPTER 6 – DESIGN CRITERIA FOR GRAVITY SEWER LINES AND APPURTENANCES

Engineer will submit a rough layout of system for review and approval by the City Engineer prior to preparation of improvement plans.

1. SEWER MAIN DEPTH AND SIZE

- A. Sewer main depth and size shall be as shown below unless approved by the City Engineer.
- B. Minimum depth, finish grade to top of pipe 6 feet
- C. Maximum depth, finish grade to top of pipe 15 feet
- D. Design calculations shall be submitted to verify size and bedding design. (Manning "N" PVC = 0.011 is norm).
- E. Minimum size of mainline shall be 8".
- F. 6" main line may be allowed on cul-de-sac streets with a maximum of 10 units.
- G. All sewer laterals and main line invert elevations shall be shown in profile on the improvement plans and shall include stations, slope, and distance.
- H. All sewer mains over 15" in diameter shall require special design and City Engineer approval.

2. SEWER LATERAL DEPTH AND SIZE

- A. 4" minimum diameter for single-family residence.
- B. 6" minimum diameter for all other use.
- C. Desirable depth at property line is 5 feet (top of pipe to finish grade @ top of curb).

3. PIPELINE MATERIAL TYPES

- A. Gravity sewer pipe and fittings shall have PVC conforming to ASTM D3034 for diameters 4" – 15" and ASTM F 679 for 18" – 24", with integral-bell gasketed joints (gasket and spigot end joint design). Pipe shall be made of PVC plastic having a cell classification of 12454-B or 12364-B as defined in ASTM D 1784 and shall have SDR of 35 and a minimum stiffness of 46 psi according to ASTM D 2412.
- B. All fittings and accessories shall be as manufactured and finished by the pipe supplier or approved equal and have bell and spigot configurations compatible with that of the pipe.

- C. PVC pipe joints shall be elastomeric gasket joints type conforming to Standard Specifications for Public Works (Greenbook) most recent edition. Rubber gaskets shall be factory installed and conform to ASTM F 477. Pipe joints shall have been tested and meet watertight performance requirements of ASTM D 3212, "Joints for Pipe Using Flexible Elastomeric Seals."
 - D. PVC C-900 shall be used for gravity sewer pipelines with depths equal or greater than 15 feet. Engineering calculations shall be provided to verify that the pipe material will accommodate the design depth.
 - E. Use of other pipe and fitting materials and types may be required by the City Engineer to meet specific conditions during design or construction.
 - F. Service connections to the sewer main shall be watertight and not protrude into the sewer pipe. All materials used to make the service connections shall be compatible with each other and with the pipe material to be joined and shall be corrosion proof.
 - G. Couplings used for repair, or transition to dissimilar pipe materials shall be approved by the City Engineer and provide corrosion proof watertight seal.
4. DESIGN PARAMETERS FOR GRAVITY SEWER MAIN SLOPE, FLOW AND DEMAND
- A. Gravity sewer pipelines shall be designed for a minimum velocity of 2 feet/second. Velocity, unless otherwise stated, shall be calculated from peak dry weather flow.
 - B. Pipeline slopes shall satisfy the minimum velocity requirement aforementioned. Maximum velocities greater than 10 ft/second should be avoided.
- Slopes for Specific Pipe Sizes 8 through 12-inch diameter:
- 1) 8" minimum 0.40% desirable 0.50%
 - 2) 10" minimum 0.28% desirable 0.40%
 - 3) 12" minimum 0.21% desirable 0.30%
- Slopes for larger than 12-inch diameter pipe shall be designed to meet flow and velocity criteria and require specific approval of the City Engineer. Pipelines with horizontal curvature will require increase slope to achieve minimum required velocities.
- C. Gravity pipelines with diameters of 12" and less shall be designed to flow at depths of 0.5D during peak hour dry weather flow. Gravity pipelines with diameters greater than 12" shall be designed to flow at depths of 0.75D during peak hour dry weather flow.
 - D. Peak hour sewer flow rates do not include infiltration or inflow (I/I). Infiltration is defined as the addition of groundwater into the sewer collection system and inflow is the addition of storm water into the sewer collection system. Because sewer collection system I/I is dependent on a number of factors including season, age of system, type of pipe material and joints, root intrusion, and presence of storm water system, the I/I flow rates will vary from system to system. The design of sewer pipelines connecting to sewer systems known to have I/I, or are susceptible to I/I, shall utilize peak wet weather flow estimates from the City of Carlsbad Sewer Master Plan or perform wet weather flow monitoring as directed by the City Engineer. Gravity pipelines designed to convey wet weather flow shall not exceed 0.90D for peak hour wet weather flow.

E. Flowrate Generation

- 1) An Equivalent Dwelling Unit (EDU) = 220 gal/day, Average Daily Flow (ADF)
- 2) For ADF less than 100,000 gal/day, a peaking factor (PF) of 2.5 multiplied times the ADF shall be used to determine Peak Daily Flows (PDF). $PDF = ADF \times 2.5$
 - a) Residential: Single Family Residence = 1 EDU
 - b) Commercial Property: 1 EDU/1,800 ft² (building space)
 - i) To convert raw land to square feet of building space, assume 30% coverage. This could vary significantly dependent development constraints.
 - ii) To convert improved pads to square feet of building space, assume 40% of coverage.
- 3) Industrial Property: 1 EDU/5,000 ft² (warehouse space)
1 EDU/1,800 ft² (office space)
 - a) To convert raw land to square feet of building space, assume 30% coverage. This could vary significantly dependent issues such as environmental restrictions.
 - b) To convert improved pads to square feet of building space, assume 40% of coverage.
 - c) Assume 60% of building space is warehouse, and 40% is office space.

5. HORIZONTAL AND VERTICAL LAYOUT

- A. Streets: See City of Carlsbad Standard Drawing No. GS-6 for location.
- B. Alley: Main to centerline shall be a minimum of three feet (3') offset.
- C. Private Street: Shall require special design and conditions. Easement shall be 20 feet minimum.
- D. Horizontal Curve: SDR 35, PVC pipe may be curved horizontally through longitudinal bending with the following limitation:

Pipe Diameter (SDR 35)	Minimum Radius of Curvature
6-inch	150 feet
8-inch	200 feet
10-inch	250 feet
12-inch	300 feet
15-inch	375 feet

City Engineer shall approve curvatures for larger diameter pipe.

- E. Vertical Curve: Vertical curves shall be permitted only when specifically approved by the City Engineer. A detailed design drawing shall be required for review and approval.
- F. Utility Clearances: Show all underground utilities in both plan and profile. Provide minimum separation per the State Department of Health Services "GUIDANCE MEMO NO. 2003-02: GUIDANCE CRITERIA FOR THE SEPARATION OF WATER MAINS AND NON-POTABLE PIPELINES".
- G. Manholes: Shall be located at areas described as follows:
- 1) Maximum spacing of manholes shall be three hundred fifty feet (350') for mains twelve inches (12") and smaller and five hundred feet (500') for mains over twelve inches (12") unless otherwise approved by the City Engineer.
 - 2) Install manholes at all changes of slope that exceeds 2% and show inlet and outlet inverts on all manholes.
 - 3) Install manholes at all changes in horizontal direction.
 - 4) Install manholes at all intersections of mains.
 - 5) Install manholes at changes of pipe sizes.
 - 6) Install manholes at the end of all sewer mains.
 - 7) All standard manholes shall be a minimum of five feet (5') in diameter with no steps. Man holes shall be sequentially numbered on the plans with manhole numbers beginning at the lowest invert. Three-foot stubs shall be provided for future tie-ins and main extensions.
 - 8) Manholes shall be PVC lined per Std. Dwg. S-1A when: depth is 15-feet or greater; slope of sewer pipe coming into the manhole is greater than 7%; all force main discharge manholes; the immediate upstream and downstream manholes of inverted siphons; drop manholes; on sewer lines 15-inch and greater; when required by the City Engineer.
 - 9) Where there is a slope change from steep to flat of 5% or greater, the manhole at the grade change and the next manhole upstream shall be PVC lined.
 - 10) Install manholes for all lateral connection in pipelines 15-inch diameter and larger.
 - 11) When intercepting flows from smaller pipelines in manholes, set invert of a smaller main at $\frac{3}{4}$ of the depth of the larger main.
 - 12) Locking manhole lids may be required in unpaved areas as directed by the City Engineer.
 - 13) The top cone shall be 6" below finished subgrade. Circular steel covers shall be placed on the manholes during subgrade preparation and base rock grade work, in order to keep the sewer system clean. Additionally, roadwork above live sewer manholes shall require plywood type sheeting be placed inside the manhole and above the channel to keep any debris from entering the sewer line.
 - 14) In unpaved areas, sewer manhole frames and covers shall be set 6" above finished grade with concrete ring and marker post marked "sewer" per Standard Drawing S-9.

- H. Cleanouts: Extend beyond permanent pavement when street is a temporary dead end. See Standard Drawing No. S-6 for type of cap and box.
- I. Laterals: Laterals shall be constructed per Std. Dwg. No. S-7. Minimum horizontal distance from water service, fire hydrants, light standards, electrical transformers, etc., is 5 feet. Desirable horizontal distance is 10 feet.
- 1) Install at right angle or radial to the main.
 - 2) Laterals shall not be located in driveways.
 - 3) No connections shall be permitted on laterals other than provided in Standard Drawing No. S-7.
 - 4) Location of property cleanout: See Standard Drawing No. S-7.
 - 5) If the lowest plumbing fixture on a property is lower than 2-feet above the nearest upstream manhole cover, then the owner must provide a Backwater Valve to prevent a sewage backup onto the property. The valve must be installed in a valve box for easy access and be visible from the public right-of-way. The property owner shall be responsible for the installation and maintenance of the sewer Backwater Valve. The Backwater Valve shall be shown on the precise grading and improvement plans.
 - 6) The Contractor shall install sewer laterals using wye fittings sized and located as shown on the Approved Plans.
 - 7) Laterals shall be bedded, backfilled and compacted in the same manner as the sewer main they are connected to.
- J. Steep Slope Protection:
- 1) Sewer pipelines on 20 percent slopes or greater shall be anchored securely with a cut-off wall per RSD SP-05 or SP-07, spaced as follows:
 - a. Not over 36 feet center to center on grades 20 percent and up to 35 percent;
 - b. Not over 24 feet center to center on grades 35 percent and up to 50 percent; and
 - c. Not over 16 feet center to center on grades 50 percent and over.
- K. All sewer mains, not located within the public right-of-way shall be provided with a minimum 20-foot wide sewer easement. In some special cases, a wider easement may be required; the City Engineer shall determine size. All easements shall be easily accessible to City maintenance equipment with all weather roadways.

6. CONNECTIONS TO EXISTING MANHOLES

New connections to existing manholes where stubs have not been provided shall be made by core drilling through the walls and base as directed by the City Engineer or their representative. If intercepting flows from smaller pipelines in manholes, set invert of a smaller main at $\frac{3}{4}$ of the depth of the larger main. Special care shall be used to facilitate the flow when forming the tributary channel into the existing channel.

7. MISCELLANEOUS REQUIREMENTS

- A. The City of Carlsbad will only maintain sewer mains located in dedicated City right-of-ways and easements which have all weather vehicular access.
- B. New sewer lines and appurtenances shall remain plugged and/or disconnected until the City authorizes its use.
- C. Maintenance of sewer laterals from the main to the building shall be the responsibility of the property owner.
- D. Sewer laterals constructed from the property line to the building shall be per the Uniform Building Code.
 - 1) The vertical cleanout shall be stubbed and capped 3 feet above rough grade during grading and/or construction of project.
 - 2) All sewer lateral taps on existing sewer lines shall be by "shower" or approved equal. All work will be inspected by a City Representative.
 - 3) A three-inch (3") high "S" shall be stamped on the curb face at all sewer lateral locations.

GENERAL GUIDELINES FOR SEWER FORCE MAINS

- 1. The developers engineer shall submit a preliminary design report showing the alignment, pipe size, pressure conditions, pipe materials, a rough layout plan including surge protection design and flow analysis for review and approval by the City Engineer prior to the preparation of improvement plans.
- 2. Minimum cover of sewer force mains shall be 48 inches (48") from top of pipe to ultimate finished grade. Top of pipe profile shall be shown on the improvement plans.
- 3. Show all other underground utilities in both plan and profile. Provide minimum clearances per the State of California Department of Public Health (CDPH) "GUIDANCE MEMO NO. 2003-02: GUIDANCE CRITERIA FOR THE SEPARATION OF WATER MAINS AND NON-POTABLE PIPELINES".
- 4. Sewer force mains shall be High Density Polyethylene (HDPE) manufactured in accordance with ASTM F714, or ductile iron pipe with polyethylene liner, and exterior corrosion control as approved by the City Engineer.
- 5. Where possible, force mains shall be designed with a continuous uphill slope without high points so that air-release valves are not required on the force mains. If this is not possible, provide air-release valves manufactured by Vent-O-Mat.
- 6. Dual force mains may be required at the discretion of the City Engineer where maintenance will be required on a regular basis or due to environmental constraints.
- 7. At the discretion of the City Engineer, Force mains longer than 1-mile or with excessive detention times may require the use of chemical addition to prevent odors at the discharge location of the force main.

GENERAL GUIDELINES FOR SEWER LIFT STATIONS

1. Sewer Lift Stations shall not be incorporated into the City's sewer system and shall be avoided if at all possible, unless deemed essential by the City Engineer.
2. The developer's engineer shall meet with the City Engineer prior to the preparation of plans to inquire about the feasibility of utilizing a lift station for a given area.
3. The lift station design shall be approved by the City Engineer and all component submittals shall go through the City Engineer for review.
4. Prepare a preliminary design report that shall be submitted to the City for review and approval. The preliminary engineering design report shall include, at a minimum, the description of the design criteria to be utilized, preliminary flow computations, design calculations, calculated systems curves, water hammer (surge) protection analysis/recommendation, identification of right-of-way requirements, number of property owners involved, listing of permit requirements, geotechnical investigation and cost estimate based on unit costs for major elements of work. In addition, the following design elements shall be developed:
 - a) Site Development
 - b) Structural Design
 - c) Architectural Design
 - d) Hydraulic Analysis
 - e) Mechanical Design
 - f) Electrical Design
 - g) Instrumentation and Process Control
 - h) Corrosion Control
 - i) Odor Control
 - j) Noise Control

The hydraulic analysis shall include calculations of the system curve. The system curve shall be plotted on the pump curve with the operating point identified. Every effort shall be made to select a pump that operates at its best efficiency point. Peak and average flows shall be considered when selecting the appropriate pump. Pump manufacturer data sheets shall also be included in the preliminary design report submission.

If the pump station is being designed with built-in expansion capability, an economic analysis shall be submitted. The analysis shall consider capital costs as well as the operational cost of the lift station. Design assumptions (e.g. cost of electricity, cost of money) shall be determined in consultation with the City of Carlsbad.

5. General Design Requirements for Sewer Lift Stations smaller than 3 MGD shall be as follows:
- a) Lift Stations shall be designed to convey the ultimate peak hour sewer flow rate including inflow and infiltration and meeting the latest requirements of the "Hydraulic Institute". No premanufactured or prefabricated lift stations will be permitted.
 - b) Lift stations shall be of the "dry-pit/wet-well" type unless approved otherwise by the City Engineer. Wet wells shall be lined with "T-LOCK" PVC.
 - c) Lift stations shall have a minimum of 2 pumps of equal size (1 duty and 1 standby). Lift stations with more than 1 Duty pump shall also provide a minimum of 1 standby pump of equal size. Additional standby pumps may be required for lift stations located near environmentally sensitive areas. Pump selection shall be approved by the City Engineer.
 - d) Lift Stations larger than 1 MGD shall utilize an onsite odor control system. Smaller lift stations may require odor control as determined by the City Engineer.
 - e) Comminutors shall be installed on the influent sewer to wet wells at all lift stations.
 - f) An emergency bypass connection shall be provided for connection to portable pumping equipment.
 - g) An emergency generator shall be provided to supply backup power (100%) to all lift station facilities.
 - h) Lift Stations shall be equipped with a magnetic flow meter and an alarm system installed on the discharge force main that shall be compatible with the City's telemetry system.
 - i) Manifold pipe shall consist of ductile iron pipe of suitable pressure class.
 - j) Appropriate lighting and ventilation with a minimum of 12 air changes per hour shall be included.
 - k) Suitable vehicle access and security fencing will be provided.
 - l) System head curves shall be developed for two "C" valves, C=120 to ensure adequate flow, and a C=150 for ensuring adequate driver horsepower and pump characteristics.
 - m) A surge analysis studying the force main and the related sewer lift station shall be performed and submitted to the City for review and approval.